

**Final Environmental Assessment of
Habitat Management Alternatives
on Arapaho National Wildlife Refuge**

**Walden, Colorado
August 1994**

Prepared by: Eugene C. Patten



**US Fish and Wildlife Service
Department of the Interior
Denver, Colorado**

**Final Environmental Assessment of
Habitat Management Alternatives
on Arapaho National Wildlife Refuge**

**Walden, Colorado
August 1994**

Prepared by: Eugene C. Patten

**US Fish and Wildlife Service
Department of the Interior
Denver, Colorado**

TABLE OF CONTENTS

I.	PURPOSE AND NEED FOR ACTION.....	1
A.	Introduction and Setting.....	1
B.	Historic Background.....	1
C.	Purpose of Action.....	7
D.	Need for Action.....	8
II.	ALTERNATIVES FOR HABITAT MANAGEMENT.....	11
A.	Introduction.....	11
B.	Habitat Management Tools Available For Use.....	11
1.	Rest.....	12
2.	Planned Grazing/Animal Impact.....	14
3.	Prescribed Burning.....	17
4.	Haying.....	19
5.	MeadowIrrigation/WaterLevelManipulation.....	21
6.	Current Technology and Future Innovation.....	22
C.	Management Alternative Considered and Evaluated.....	24
1.	No Management (Balance of Nature) Alternative.....	25
2.	Prescribed Burning with Irrigation/Water Management Alternative.....	26
3.	Planned Grazing with Irrigation/Water Management Alternative.....	26
4.	(No Change from Present Management) Inter-Disciplinary/Integrated Management.....	26
D.	Management Alternatives Considered But Not Evaluated.....	28
1.	Increased Economic Return Alternative.....	28
2.	Historic Landscape (Native American) Alternative.....	28
III.	THE AFFECTED ENVIRONMENT.....	29
IV.	ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES.....	32
A.	No Management (Balance of Nature) Alternative.....	32
B.	Prescribed Burning with Irrigation/Water Management Alternative.....	33
C.	Planned Grazing with Irrigation/Water Management Alternative.....	34
D.	(No Change from Present Management) Inter-Disciplinary/Integrated Management [Ecosystem Based] Alternative - "Preferred Alternative".....	36
V.	CONSULTATION AND COORDINATION.....	37

I. PURPOSE AND NEED FOR ACTION

A. Introduction and Setting

Arapaho National Wildlife Refuge was established in 1967 "for use as an inviolate sanctuary or for any other management purpose, for migratory birds". Authority to acquire the refuge was granted by the Migratory Bird Conservation Commission, acting under the authority of the Migratory Bird Conservation Act. The Commission's basic approval occurred in August 1967.

The refuge is located in an intermountain glacial basin just south of the town of Walden, the county seat of Jackson County, Colorado. The basin is approximately 30 miles wide and 45 miles long. Commonly known as "North Park" since it is the most northern of four such "parks" in Colorado. Jackson County is a high, isolated intermontane basin that lies in the northern tier of Colorado counties.

Forming the headwaters of the North Platte River, the basin opens north into Wyoming and is rimmed on the west by the Park Range, on the south by the Rabbit Ears Range, and on the east by the Medicine Bow Range. Elevation ranges from 7,800 to 12,953 feet above sea level. The floor of the basin is interspersed with many slow meandering streams that come together in the north central part of the county to form the North Platte River. Main tributary rivers are the Michigan, Illinois, Canadian and Grizzly.

A major portion of the bottom land along the streams is irrigated hay meadow and irrigated pasture while the low rises between streams are dry grassland and sagebrush grazing lands. The picture changes rapidly on the edges of the basin where the land pitches abruptly upward to the mountain tops, the slopes heavily clothed with aspen, spruce, pine, and fir up to timberline at about 11,000 feet, then tundra and rock up to the mountain summits.

B. Historic Background

Prior to 1820 the Ute Indians spent their summers in North Park, living on deer, buffalo, antelope, and many other kinds of game. The severity of the winters forced both the Indians and the game down to lower altitudes in the fall.

The Arapahos' also made frequent hunting trips into North Park coming in from the southwest over a pass described by Lt. John F. Fremont, as

one of the most beautiful he had ever seen. The Utes and Arapahoes were bitter enemies, and there were many battles when they chanced to meet. Besides their well worn trails, other mute evidence of Indian life of pre-settlement time still exists in North Park. A band of Utes who participated in the Meeker, Colorado massacre in 1879 fled to North Park after the incident and spent the winter in the north end of the Park. Several large log tepees left by this band of Utes; still stand (1994) in a sheltered and secluded spot in the north end of Jackson County.

The first Europeans to visit and explore North Park were probably trappers, who were in northwestern Colorado as early as 1819. Beaver were particularly abundant along North Park's streams. In 1820, Josephy Bijeau told of the good trapping he had experienced in North Park a few years prior, while with the Chateau and DeMunn Expedition. About the same time, 1820, Jacques Laramie trapped in the Park for the Northwest Fur Company. He was followed by a party of trappers headed by Alexander Sinclair and Robert Bean who trapped beaver in the Park in 1825. A number of trappers visited the Park into the 1840's including Peg Smith, John Gantt, Kit Carson, Henry Fraeb, Calvin Jones, Bill Williams, Jim Baker, Jim Bridger, Sublette, Gervais and Vasquez. In 1855, the famous Irish hunter Sir George Gore made a spectacular hunting trip through North park, killing thousands of deer, buffalo, and antelope.

The second western expedition of John C. Fremont took him through North Park in 1844, during which observations of the flora and fauna were made. Fremont's party entered the Park on June 15, 1844 and his description of the Park was as follows:

"The valley narrowed as we ascended, and presently degenerated into a gorge, through which the river passes as through a gate. We entered it, and found ourselves in the New Park - a beautiful circular valley of thirty miles diameter, walled in all round with snowy mountains, rich with water and with grass, fringed with pine on the mountain sides below the snow line, and a paradise to all grazing animals. The Indian name for it signifies "cow lodge," of which our own may be considered a translation; the enclosure, the grass, the water, and the herds of buffalo roaming over it, naturally presenting the idea of a park. We halted for the night just within the gate, and expected, as usual, to see herds of buffalo; but an Arapaho village had been before us, and not one was to be seen. Latitude of the encampment 40 52'44". Elevation by the boiling point 7,720 feet.

It is from this elevated cove, and from the gorges of the surrounding mountains, and some lakes within their bosoms, that the Great Platte river collects its first waters, and certainly no river could ask a more beautiful origin.

16th. - In the morning we pursued our way through the Park, following a principal branch of the Platte, and crossing, among many smaller ones, a bold stream, scarcely fordable, called Lodge Pole Fork, and which issues from a lake in the mountains on the right, ten miles long. In the evening we encamped on a small stream near the upper end of the Park. Latitude of the camp 40 33'22".

17th. - We continued our way among the waters of the Park over the foot-hills of the bordering mountains, where we found good pasturage, and surprised and killed some buffalo. We fell into a broad and excellent trail, made by buffalo, where a wagon would pass with ease; and, in the course of the morning we crossed the summit of the Rocky Mountains, through a pass which was one of the most beautiful we had ever seen. The trail led among the aspens, through open ground, richly covered with grass, and carried us over an elevation of about 9,000 feet above the level of the sea." (Fremont 1850:413-414)

Miners and prospectors followed the trappers and hunters to North Park. James O. Pinkham was one of the first prospectors in North Park and began panning gold in the Park in the early 1870's spending the long cold winters in Laramie, Wyoming, and the summers in North Park. He believed that North Park was the richest and finest country in the world, and built a home in the Park in 1874. Mr. Pinkham interested others in North Park through his tales of rich placer land, and by 1875 there were nearly a hundred men prospecting for placer gold around Rabbit Ears, Independence, and Owl Mountains.

When the prospectors made their trips in and out of North Park in the early days, they carried with them tales of a stockman's paradise, with tall lush grass higher than an antelope's back. In the late summer, when the seeds were ripening, the grass looked like fields of waving grain. It did not take the cattlemen of the plains long to profit by this news. In the summer of 1878, Reid Matthews, who was running a wholesale butcher business in Leadville, bought a herd of cattle in Utah and drove them into North Park where he fattened them on the lush grass and then in the fall,

drove them to Leadville to be butchered. In November 1878, Jacob S. Fordyce brought his family and a herd of milk cows into North Park and settled in the north end of the Park on the banks of the Platte River. They stayed the entire winter, milked the cows, and packed the butter in tubs to be sold in Laramie, Wyoming, in the spring. The Fordyces were the first white family to spend the winter in North Park.

In 1879, there was a drought in the area around Fort Collins, Livermore, and Virginia Dale and the stockmen had to seek new pastures for their herds. In spite of North Park being thought of as Indian country, some of the bravest decided to take a chance and drive their cattle into the North Park basin. C.B. Mendenhall brought 3,000 head of Texas steers to North Park to graze. Other ranchers brought in cattle at the same time, but following the Meeker Massacre in the fall 1879, all of the ranchers except C.B. Mendenhall and two others, drove their cattle out of North Park. The following summer, many ranchers drove their cattle into North Park to graze and later, many people followed to start their own ranches in the Park.

1879 saw the beginning of silver excitement at Teller City. The mines started operating in 1879, and by 1880, Teller City had a population of nearly 2,000. In 1882 a toll road over Cameron Pass from Fort Collins to Teller City was completed. Good veins of silver, gold, and some lead were discovered, but transportation was so expensive that the miners could not afford to ship the precious metals, and by 1885 Teller City was abandoned.

By 1888, most of the gold and silver mining was abandoned and those who had never struck it rich began ranching as a livelihood. By the turn of the century all of the best ranch land along the rivers was fenced off and homesteaded.

The first settlers lived on wild game and hunting was as much a business of the men as attending to their ranch work. North Park in the late 1880's was a paradise of game. There were thousands of antelope which summered in the Park and migrated to the lower valleys in Wyoming during the winter. There were also hundreds of deer and elk in the Park, but their numbers diminished after the arrival of settlers. There were also three buffalo left in the Park when the first settlers came, but they soon disappeared. There were many bears, mountain lions, mountain sheep, and beaver, and thousands of sage hens, grouse, and ducks in the early days. There were no trout in any of the North Park streams when the first settlers came, but in the 1880's settlers stocked the streams with Native Trout, Eastern Brook Trout, and Rainbow Trout.

Sheep raising in Jackson County began in 1918 with about 500 head being raised in small flocks on ranches for home consumption. After the Depression of 1921, when many cattlemen went broke, North Park ranchers began putting flocks of sheep on the ranges, but cattle ranching remained the dominant form of ranching in Jackson County. When the stockmen first drove their herds into North Park, they believed that the cattle and horses could survive year around on the fine wild hay. However, the winter of 1883-1884 was severe and half of the stock died. As a result, most of the ranchers purchased mowers and rakes prior to the following summer's haying season in preparation for putting up the wild hay for winter feed.

Hay has always been the main agricultural crop in Jackson County, with about one hundred thousand acres being in native mountain hay and only three hundred and seventy acres in other crops. For years all the hay was fed inside North Park, but in 1914, ranchers began to bale and sell the hay outside the Park.

By the early 1890's, North Park was fairly well settled in every direction, and a central point for securing supplies became necessary. As a result, the Town of Walden, elevation 8,100 feet, the present County seat, was established in the middle of North Park located in the vicinity of two wagon roads from Laramie to Teller City and from Albany to Granby. The town was named after Mark S. Walden who was postmaster of the nearby settlement, Sage Hen Springs.

Until the coming of the railroad in 1911, all supplies were hauled into the Park by wagon teams from Laramie. The freighters used two or three wagons and a twelve or fourteen horse team driven with a jerk line.

A mining boom similar to the Teller City boom, developed at Pearl where copper was discovered in 1900. Six mines, the Wolverine, Swede Graup, Big Horn, Tully, Zirkle, and Round Top, were developed and operated by steam power. A large smelter was built in 1905, however, the smelter ran only one day and was then abandoned because of the high cost of transportation.

Much of North Park is known to be underlaid with good quality coal. At least a dozen mines have produced coal for neighborhood use at various times. In 1890 the Riach brothers discovered a good grade of coal on their ranch 18 miles south of Walden. In 1905 an eastern firm bought the land and began to develop the mine. The Laramie, Hahn's Peak and Pacific Railroad was built to the mine in 1911 and the town of Coalmont was founded. Coal was shipped outside the Park for many years. The

mines and the Town of Coalmont are owned by the North Park Coal Company headed by L.C. Moore of Fort Collins, but at the present time the mines are not operating. Three open cut coal mines began operations in Jackson County in 1974. The last of the three mines located east of Walden ceased operations in 1993.

Fluorspar was discovered near the Wyoming border in 1908. Several claims were purchased by the Colorado Fluorspar Corporation, which shipped 18,000 tons before closing down in 1926. The mines were reopened during World War II and were subsequently purchased by the Ozark-Mahoning Company which increased production to 100 tons daily until closing down in 1959. The Fluorspar mine was reopened in 1969, and was under full production until it shut down in 1974.

The first oil well was drilled in Jackson County in 1926 by the Continental Oil Company, thus establishing the North McCallum Oil Field. By 1960 the field was producing 2.5 million dollars worth of oil annually. Production from this field has declined over the years, but other fields such as the Lone Pine field have preserved the oil industry in Jackson County, at least for the time being.

In the mid 1930's, commercial lumbering began in the Park, and today remains an important part of the County's economic base. Presently Louisiana Pacific Corporation operates a sawmill at Walden that processes 28 to 30 million board feet annually. The saw mill is currently the largest employer in Jackson County with approximately 90 employees.

In the fall of 1984, Liquid Carbonic (Carbon Dioxide) Corporation constructed a gasification plant adjacent to Continental Oil Company, a few miles northeast of Walden. The company produces liquid CO₂ and dry ice which is distributed in a five state area to bottling companies, the oil fracing industry and other distributors. The company currently employs 18 people.

The economy of Jackson County today is based primarily on ranching and agriculture, but also relies on mineral production, logging operations, and recreation. The economic base has been fairly stable throughout the history of Jackson County with some fluctuations caused by the instability of the mining industry.

Recreation is becoming more and more of an economic importance to Jackson County. The County's many streams, lakes, uplands, timbered areas and mountains, most with public access, offer unusual opportunities for outdoor recreational activities such as hunting, fishing, bird watching,

backpacking, camping, snowmobiling, cross country skiing, bicycling, and many other activities.

C. Purpose of Action

The purpose of this Environmental Assessment (EA) is to review and evaluate those current habitat management tools available for implementation by refuge staff to more effectively and efficiently achieve the mission, goals and associated objectives for which the refuge was established. Some or all of these habitat management techniques or treatments either individually or in various combinations would be used on refuge uplands, meadows and marsh/riparian areas to accomplish the following directly or indirectly related goals and associated objectives in priority order:

Goal I - Provide the life requirements, including the necessary amount of management and protection, to assure the survival of endangered/threatened species on the refuge.

1. Provide quality habitat for endangered/threatened species to the extent possible for the small numbers of peregrine falcons, bald eagles, river otter and greater sandhill crane that utilize the refuge on a permanent or seasonal basis. (Note: The river otter and greater sandhill crane are listed species by the State of Colorado only.)
2. Provide necessary protection through the use of restricted public use programs, closed areas, etc., to ensure that endangered and/or threatened species are adequately protected and remain relatively undisturbed on refuge lands.

Goal II - Provide high quality breeding, nesting, and brood rearing habitat for the production of migratory waterfowl.

1. Develop and manage waterfowl habitat to produce between 11,000 and 12,000 ducks and 500 Canada geese annually.
2. Manage nesting habitat and predator populations to ensure an annual minimum of 30 to 40 percent nesting success for waterfowl (Mayfield method).

Goal III - Provide the life requirements including the necessary amount of management and protection to assure the survival of all other wildlife and plant species on the refuge.

1. Improve and maintain the condition, vigor and productivity of refuge marshes and ponds, meadows and sagebrush-grassland uplands for the benefit of all indigenous species of wildlife utilizing them.
2. Improve and protect the Illinois riparian habitat for the benefit of brown trout and other fish species, mule deer, elk, moose, and various other species of wildlife that utilize the riparian areas.

Goal IV - Provide high quality wildlife oriented recreational and interpretive opportunities.

1. Provide access to portions of the refuge, (tour routes, roads, foot trails, etc.) in combination with various interpretive displays where the general public can enjoy wildlife/wildlands oriented activities in a relatively undisturbed setting.
2. Provide high quality hunting and fishing recreational opportunities on portions of the refuge that are compatible with available natural resources.

All of the above goals and objectives complement the refuge mission to increase and sustain wildlife production on refuge uplands, meadows, and associated marshes and riparian areas. They contribute to the ultimate goal of providing and maintaining a healthy and productive ecosystem rich in biological diversity for the benefit of all.

D. Need for Action

The proper management and preservation of Arapaho's sagebrush-grassland, meadow and marsh/riparian communities is essential not only in achieving refuge goals and objectives but is also necessary in order to provide a healthy and diverse ecosystem that is sustainable on a long-term basis.

Prior to refuge acquisition most meadow areas were flood irrigated during the months of May and June and then hayed beginning in mid to late July. Cattle were then released on these hayed fields to graze on the aftermath and any new fall vegetative growth. Prior to winter weather setting in, the cattle were moved to pastures nearer base ranch operations where they were either winter fed or sold. Weather permitting, many of the hayed fields were fertilized in late fall or the following spring primarily with ammonium nitrate. Trace elements such as phosphorous, zinc, iron and potassium were also added when necessary. Prior to the spring irrigation

season the fields were worked with a light harrow to break up and uniformly spread animal residues throughout the meadows. At times, willows along the Illinois River would either be killed by aerial spraying or cleared with heavy equipment in attempt to provide a better opportunity for grass and grass like plants to grow. Most sagebrush-grasslands were grazed to some degree in the spring, summer and fall. Season long grazing was common in many fields and probably resulted in over-grazing and over-resting occurring at the same time in many fields. Aerial spraying for sagebrush control did occur on some of the uplands within the current refuge boundary.

Upon refuge acquisition, all haying was curtailed on the meadows, aerial spraying of sagebrush and willows was eliminated and several refuge upland areas were rested for several years while other areas were grazed at a light to moderate rate during the spring, summer, and fall. Grazing was not permitted until after August 1 on most of the meadows. Grazing was on a rest-rotational basis at various stocking rates. Some meadows remained in rest status for several years.

In the late 1980's haying was initiated on a cooperative crop share basis on one small 138 acre former hay field, primarily to provide a wet hayed meadow on the refuge each spring to attract waterfowl and other migratory birds. In 1988, high intensity, short duration grazing was initiated on selected areas of the refuge to restore plant vigor and enhance community diversity. This grazing system requires considerable attention and flexibility in increasing overall benefits to wildlife and the habitat.

In addition to the above mentioned habitat management techniques the refuge currently utilizes complete annual rest, seasonal rotational and rest-rotational grazing at various grazing intensities, prescribed burning, meadow irrigation, water level manipulation, vegetative transplants, grass seeding and noxious weed control to help maintain refuge habitats in an overall optimum condition.

Most of the refuge plant communities appear to be in fair to good condition. An exception might be some of the sagebrush-grassland which have had a history of over-grazing and over-resting in the same fields. Some refuge meadows have also deteriorated as a result of being rested for several years without any habitat manipulation treatments being initiated.

Some problems the refuge faces in managing refuge habitats for wildlife, particularly waterfowl and other migratory birds are:

- Lack of dependable early water supplies every year for irrigation of the refuge meadows and the filling of ponds and marshes. Those wetlands containing sufficient winter "carry over" water are plagued by late springs most years, thus "open water" areas are not available for migrating waterfowl and other waterbirds until well after the initial spring migration has commenced.
- Although improvements could be made in the refuge's gravity flow flood irrigation system for better control and efficient use of available water, the refuge receives uncontrollable return irrigation flows from upstream water users throughout much of the summer.
- Without some type of habitat treatment the dense residual vegetation of the meadows is subject to extensive matting as wind and heavy snows pack it down most winters. In a no treatment situation over a short period of years, this dense mat of accumulated mulch keeps soil temperatures low and penetration of sunlight to a minimum which inhibits new plant growth and ultimately reduces the quality of cover for most wildlife species.
- Habitat management is also hindered on other areas of the refuge due to inherited poor fencing patterns, deteriorated fences and in some areas a complete lack of fence, all of which preclude implementing any type of grazing system to improve overall habitat condition. The refuge does not have sufficient personnel or funding to correct these fence removal and re-fencing needs as soon as we would like.

One of the major questions facing refuge personnel in the management of refuge's habitats, particularly the meadow and sagebrush-grassland communities, is trying to determine what type of habitat manipulations are necessary and which management tools to use to provide optimum habitat conditions for a variety of wildlife. We don't have all the answers and we don't know of anybody who does, despite all the research conducted over the years and the available literature concerning wildlife habitat management involving such tools as prescribed burning, haying, grazing, rest, seeding, and irrigation. Research results are often conflicting. And, research done in different habitats cannot be applied to other areas with certainty.

The problem of which management strategies to use at Arapaho is particularly acute, since the refuge lies at an elevation above 8,000 feet msl and the North Park area is classified climatically as a cold desert with an extremely short growing season.

II. ALTERNATIVES FOR HABITAT MANAGEMENT

A. Introduction

Waterfowl production and management of other migratory birds are the primary purposes for which the refuge was acquired and is managed. Past and current waterfowl research indicates that most species of upland nesting waterfowl prefer tall, dense cover for nesting. Research also suggests that nesting success is better in tall, dense cover, and that erect residual vegetation is also important to upland nesting waterfowl, especially for early nesting species.

The vegetation habitat needs of other migratory birds are more diverse than those of most nesting waterfowl. Habitat conditions best suited for the management of other migratory birds and resident wildlife are created by providing a mosaic of various degrees of height, density, successional stages and amounts of residual cover. Plant species diversity and edge affect are also very important.

Refuge goals and objectives will be met through the use of various management tools to achieve the conditions stated above. Although the above description indicates plant communities with tall, dense vegetation and a large percentage of upright residual cover best serves waterfowl production, the habitat needs of other migratory birds will also be provided.

Grasses and grassland-associated forbs and shrubs evolved with and require periodic disturbance to maintain a healthy, vigorous plant community. These disturbances must be relatively short in duration and vary from partial to total defoliation. Due to the diverse habitat types found on the refuge and the need to manage for tall, dense residual cover, particularly in meadow and associated wetland areas, frequent periods of disturbance over time will be required. These disturbance periods will also provide the various degrees of vegetation height and density, successional stages, and amount of residual cover required by other migratory birds and wildlife.

B. Habitat Management Tools Available For Use

Intermountain park land ecosystems including North Park, evolved with disturbances which were primarily large ungulate grazing, varying degrees of vegetative trampling and fire. Climatic conditions also played a major role. Today bison are virtually gone from their original range and most wildfires are quickly suppressed.

Below are descriptions of several disturbances (tool) which are used to manage habitats on the refuge. These management treatments are referred to as an attempt to mimic, to the extent possible, those disturbances that occurred prior to European settlement.

Each tool and/or combination of tools may have different effects on the environment. The application of the tools and/or combination of the tools is virtually unlimited; therefore, it is impossible to determine exactly the effects each will have on the various plant communities. This discussion will address only the general benefits and detrimental effects of each tool.

Determining if, when, and which management tool will be used, depends upon the type of landscape desired, its current conditions, which way it's heading, type of management tool now being used if any, etc.

Determining the need for management is often not difficult. Indicators include, but are not limited to, the build up of matted (lodged) residual vegetation, reduced plant vigor, declining vegetative diversity in sagebrush-grassland, uplands and meadows, and declining use by wildlife. Identifying the characteristics of the successful use of a management tool is not as easy. Determining when the currently employed technique is not working can be even more difficult. Often this relies on experience of how various plant communities react in different conditions and areas.

1. Rest

Rest as discussed here refers to the intentional complete removal of habitat disturbance tools (grazing, burning, haying, etc.) on a specified area over a given period of time. Long-term rest usually involves more than one growing season while short-term rest is less than a year but usually allows for complete plant regrowth or substantial recovery of the plant following disturbance.

When utilized as a planned component in combination with, or in addition to, other management tools, rest periods are essential to the recovery of the plant community following disturbance by other management tools. Rest gives plants the opportunity to restore health and vigor by recovering lost stored food reserves and reestablishing root systems.

With Arapaho's high elevation, short growing season and usually severe and long winters, long-term rest tends to result in a loss of upland plant diversity and vigor and increased amount of bare soil. Meadow and marsh vegetation, although responding with thick

upright vegetation initially, eventually becomes matted with little new growth accompanied by reduced vigor and plant diversity.

Some of the beneficial effects of rest are:

- Rest can be used to provide residual standing vegetation for use by wildlife as breeding, nesting, roosting, bedding, feeding, calving, fawning and escape cover.
- Residual vegetation can reduce soil erosion and drying of soils.
- Residual vegetation can trap additional moisture in the form of snow and reduce water erosion and flooding problems during spring runoff.
- Periods without disturbance (rest) are required to maintain plant vigor.
- Reduces activities that may otherwise disturb wildlife.
- In some situations may be used to control some noxious weeds.
- May result in increased use by some wildlife species which are adapted to the habitat conditions presented by rest.

Some of the detrimental effects of rest are:

- Reduced plant litter on the soil surface.
- Long term rest can reduce plant vigor and plant diversity.
- Soils may become capped resulting in decreased water infiltration, nutrient cycling and energy flow.
- Noxious weeds and undesirable and woody vegetation could invade upland and meadow habitats because of reduced vigor of desired plants, competition by exotic plants and the lack of other disturbances.
- Succession can be reversed resulting in communities of algae, lichen and moss between grass plants.

- Can result in high puffiness and lack of compaction in certain soils, in cold, dry winter climates.
- May result in decreased use by some wildlife species which are adapted to tall, dense vegetation or vegetation with structure diversity.

In summary, rest can be beneficial or detrimental, timing and duration of use are extremely crucial.

2. Planned Grazing/Animal Impact

The effects of grazing on various vegetative communities and associated wildlife would appear to have been researched to death if one reviews all the available literature. Yet, despite all the studies and research conducted over the past 50+ years, most researchers and many public land managers for that matter, cannot agree or come to a general consensus on whether any, some, or most aspects of various grazing systems utilizing livestock or even original native herbivores can be beneficial to various plant communities and their associated indigenous wildlife species.

All of the various grazing studies and research that have taken place over the years will not be discussed here. Instead, a few undisputable, historical facts concerning animal grazing in North Park in general and the refuge in particular will be briefly presented. Both the beneficial and detrimental effect and/or tendencies of grazing will be described. The reviewer then can determine whether there is sufficient evidence to support some aspect of grazing as one of many management tools available to maintain plant communities and sustain overall biotic diversity.

As briefly mentioned in the historical background section of this environmental assessment, the first non-native Americans to explore, hunt and trap in North Park in the early 1800's reportedly observed thousands of grazing and browsing animals including bison, elk, mule deer and pronghorn antelope. Their wildlife observation accounts are documented in various diaries, journals and books.

Mr. Don Gore (pers. comm.) retired District Wildlife Manager with the Colorado Division of Wildlife stated that when he first came to North Park in the 1940's, bison horns were still very common over much of the uplands and some meadows in the Park.

Although, most of the horns have been picked up by various individuals over the years, horns can still be found today and have been located on nearly all areas of the refuge.

Native plant species found on the refuge evolved overtime under grazing by wild herbivores and by natural and man-made disturbances such as fire. Plant communities changes as these outside forces changed. For certain, individual plant species, and the various plant communities they form, did not evolve without substantial and repeated disturbance from something.

Further, the various wildlife species which make their home on the refuge in these plant communities also evolved and adapted their life cycles and behavioral characteristics in response to the changes occurring within the plant communities. Hence, duplicating these forces with the tools available to us today, principally fire and grazing by domestic livestock, would emulate the natural conditions and perpetuate the native and natural life cycles that have always existed on the refuge.

For the purposes of management on Arapaho National Wildlife Refuge, grazing and animal impact will be considered as one management tool. Although one is usually used in concert with the other, each is actually a separate management tool that can be used to achieve different desired effects on the habitat.

Grazing is the clipping and removal of leaf from grasses and forbs by large herbivores while animal impact includes all the behavioral actions these animals do while present on a particular plant community except the grazing of plants. This includes trampling, walking, running, rubbing, dunging, urinating and herding.

Some of the beneficial effects of grazing/animal impact are:

- Maintains and/or increases vigor of perennial grasses and their root systems.
- Increases production of above and below-ground plant parts.
- Prevents premature death of plants and their roots due to lodging and build up of old plant material.
- Speeds the recycling of nutrients.

- Saliva from large grazing animals may be absorbed and utilized by grazed plants for increased growth.
- Animal impact can break up capped soils and compact soil underneath the surface.
- Return plant material to the soil surface to cover it as dung, urine and litter through feeding and trampling.
- Dormant season grazing can help to accomplish seedling establishment.
- Grazing animal presence may reduce predation on ground nesting species by small mammalian predators.
- May be used to mimic to the extent possible, historic natural grazing patterns by bison prior to settlement by Europeans.
- Large animal grazing (cattle, bison, etc.) can improve future forage conditions for other native wildlife such as elk, deer, pronghorn antelope and geese.

Some of the detrimental effects of grazing and animal impact are:

- Overgrazing (the removal of a high proportion of the grass leaf surface when the plant is growing on roots sacrificed to provide that growth in not allowing the plant to recover) weakens and eventually kills the plant if persistent.
- Season long grazing can eventually lead to reduced plant vigor and decreased plant diversity.
- Overgrazing can increase soil compaction and reverse plant succession.
- Severe vegetation removal can have short and long term negative effects on wildlife habitat by decreasing water infiltration, increasing soil erosion, and drying of soils.
- The presence of livestock may be disturbing to some wildlife species such as moose, elk, deer and pronghorn antelope.

- Depending upon the type of fences required to conduct proper grazing management, they can deter normal wildlife movements.
- Grazing facilities such as fences, watering tanks, windmills, etc., can negatively affect visual aesthetics.

Sagebrush/grassland uplands and irrigated/sub-irrigated meadows are the main vegetative types on Arapaho National Wildlife Refuge. The plants associated with these two communities evolved for the most part with some type of periodic disturbance or defoliation to maintain diversity and vigor. Vegetative vigor and diversity is a necessary and required component of the landscape if refuge goals and objectives are to be realized. Grazing/animal

impact is one of the primary tools available to help accomplish these goals and objectives.

3. Prescribed Burning

Fires were regular, natural forces in buffalo (bison) country, including North Park. Lightning started many blazes, which nurtured by dry grasses, forbs, and/or shrubs, often flared out of control. Native Americans sometimes set grasslands afire, using such man-made conflagrations for a number of purposes - to send messages, to harass inimical neighbors, and to divert or drive buffalo. Fire, whether set or caused by lightning has played a significant role in the maintenance and perpetuation of the inter-mountain park ecosystem for probably thousands of years.

Where native plant communities make-up a major portion of a habitat management area such as the refuge, the primary reasons for burning are to restore, enhance and maintain habitat for a variety of wildlife. The effects of prescribed burning are largely dependent upon the degree and duration of the heat produced which in turn is determined by such factors as the type of burn, amount of available fuel, season of the year and how often a specific area is burned.

Some of the beneficial effects of using fire as a habitat management tool are:

- Can increase local diversity by creating a mosaic of habitats with increased interspersed and edge.

- Burned soil surfaces warm more quickly in the spring which often increase microbial activity, seed germination, sprouting, and overall plant growth.
- Providing adequate soil moisture is present, burning generally increases vegetative growth and plant production. Plants are often greener, larger, and more vigorous, often attracting large grazing herbivores and other wildlife.
- Makes some nutrients more soluble and therefore more readily available by plants for growth. This can be very important in cool, dry climates such as North Park where the decomposition of organic matter is very slow.
- Can increase the amount of nitrogen available for plant growth due to the increased microbial activity following a burn.
- Invigorates and thickens the growth of most woody shrub plants (willows along a riparian zone)
- Invigorates most mature bunch grass plants by removing old plant material.
- Removes vegetation and litter and therefore favors early successional plant communities over later successional stages.
- Depending upon season and magnitude of use can favor many grasses and forbs and temporarily reduce some shrubs, and destroy other non-sprouting woody species.
- May be used to reduce wildfire danger by removing old accumulated vegetation and mulch.

Some of the detrimental effects of using fire as a habitat management tool are:

- Can create conditions for increased soil erosion due to bare ground where wind and water can increase the rate of loss of soil moisture.
- Depending upon the seasons of use, may destroy the nests of ground nesting birds.

- May occasionally kill some sedentary wildlife species depending on severity of the burn.
- May reduce soil fertility and organic content if conducted too often.
- Particulates in smoke from burns can seriously reduce visibility and may cause traffic pollution and health problems in the immediate vicinity.
- Burning can increase some undesirable plant species such as rabbitbrush and Canada thistle.
- Conducting a successful burn requires intensive planning, precise timing, availability of logistical support and cooperative weather conditions.
- May cause the temporary reduction of soil microflora and microfauna, particularly in wet meadow type soils.
- Continued burning can reduce plant diversity resulting in more of a monotype plant community, particularly in irrigated and sub-irrigated meadows and marshes.

The use of prescribed burning as a habitat management tool on a limited basis began in the early 1980's. Small (200 to 300 acre) early spring burns have been conducted on grasslands to increase grass and forb vigor and diversity. Small early spring burns have also been conducted in some riparian areas with old, decadent willows to stimulate new willow growth.

Prescribed burning can be a very useful management tool for specialized purposes or when other tools are not available or cannot be effectively used to accomplish specific habitat management objectives. All prescribed burning treatments on the refuge have been conducted within the parameters established in the refuge Fire Management Plan and are individually guided by approved annual burn proposals.

4. Haying

Haying is another habitat management tool that can be used in some situations involving certain habitat types to enhance or maintain plant communities and provide habitat for specific

wildlife species. The primary and most critical aspect of using haying as a management tool is the timing of its use. Haying as discussed here refers to the normal 90 percent or more removal of vegetation.

Some of the beneficial effects of haying are:

- May be used to rejuvenate the vigor, height and density of vegetation.
- Prevents decline and premature death due to build up of old plant material.
- Removes lodged or matted residual vegetation which inhibits the growth of new vegetation.
- The timing of haying is usually controlled easier than the use of other treatment methods.
- Haying can be used to help control the infestation of meadows with noxious weeds and other undesirable species.
- Can stimulate seedling development or growth of desirable plants.
- Can be used to attract certain migratory birds such as waterfowl the following spring.

Some of the detrimental effects of haying are:

- Improperly timed annual haying can result in lost plant vigor.
- Plant diversity can be reduced and succession reversed.
- Haying operations if not delayed until most wildlife species have nested can destroy nests and kill many wildlife species.
- Vegetation removal interrupts and/or stops soil building and nutrient recycling activities.
- Can cause decreased water infiltration, soil erosion and

drying of soils.

- Haying operations usually require the use of fuels and equipment, which may add to environmental pollution.

In summary, haying has many of the same beneficial and detriment effects as other management tools. Haying, however, has a greater limited range of applications than does grazing/animal impact. When using haying as a management tool, timing is very critical, particularly in regards to ground nesting wildlife species.

5. Meadow Irrigation/Water Level Manipulation

With nearly 8,000 acres of irrigated and sub-irrigated meadows along with approximately 1,000 acres of individual ponds, marshes, and riparian areas, proper water management is very crucial to sustaining the overall health of the various refuge habitats. The refuge relies heavily upon irrigation water for habitat management purposes via 49 full or partially owned water rights involving over 320 cfs of water. The Illinois River is the primary source of refuge water (over 300 cfs), while Spring Creek, Potter Creek and Antelope Creek provide a combined total of less than 20 cfs of water. Fourteen headgates located along the Illinois River divert water into more than 70 miles of primary irrigation ditches. Secondary and spreader ditches then transport the water to flood irrigate the meadows and recharge individual ponds to maintain and perpetuate quality migratory bird resting, breeding and nesting habitat.

Some beneficial effects of meadow irrigation and water level manipulation are:

- Provides shallow, well dispersed open water areas as soon as possible in the early spring.
- Attracts waterfowl and other migratory birds for feeding, nesting, and breeding purposes.
- Shallow water areas warm up faster in the spring, producing various invertebrates which provide necessary protein for egg laying purposes.
- Provides high quality nesting and brood rearing habitat for migratory waterfowl, marsh birds and other wildlife.

- A mosaic of meadow habitat's ranging from heavy dense residual vegetation to light or no residual vegetation provides a diverse habitat for the needs of various wildlife species.
- Water level manipulation of individual ponds on a scheduled basis allows for the rejuvenation and increased productivity of those ponds or marshes.

Some detrimental effects of meadow irrigation and water level manipulation are:

- Flooding of meadow vegetation with cold water in the early spring inhibits plant growth.
- Excessive and continuous irrigation results in water logged soils and can eventually alter plant species composition of the meadow (from mixture of grasses and sedges to all sedges).
- Irrigation and water level manipulation activities normally require constant attention and usually involve extensive maintenance costs on an annual basis.
- The excessive removal of water from streams and/or creeks for other purposes can potentially negatively effect riparian habitat and associated wildlife downstream (Platte River watershed system).
- The degree of irrigation and water level manipulation are subject to the amount of water available annually.
- Some early nesting birds may lose their nests due to meadow flooding.

Overall, water management is probably the most important habitat management tool on the refuge. Without it, most other management tools would not be needed as only representative numbers of migratory waterfowl and other water associated wildlife species would be present.

6. Current Technology and Future Innovation

Technology includes all of the various methods, techniques, and inventions of modern civilization that can be utilized to manipulate and enhance the landscape. Innovation includes all yet unknown methods, techniques and inventions that may have application in the immediate future.

The application of these other management tools is primarily on a limited basis and is usually conducted in conjunction with, or prior to, or following the use of other primary management tools. These other potential tools include such things as seeding, inter-seeding, fertilizing, fencing, water developments, vegetative transplanting, noxious weed management (chemical, mowing, livestock, biological control) etc.

Since the entire refuge for the most part, is in vegetative cover of some type, seeding has limited application on the refuge. Seeding of native plant species has been conducted on small acreages where existing plant communities have been disturbed such as barrow areas and associated dikes involving wetland development projects and other construction type projects. Inter-seeding existing sagebrush-grasslands and/or meadows with native grass and forb species to improve overall plant diversity has not been attempted. Although this habitat improvement technique is feasible in some situations, it is expensive and requires the use of specialized equipment. Both of these management tools would have minimal disturbance effects on wildlife as these techniques are normally used prior to or after the growing season.

The application of fertilizers either aerially or with ground equipment is another techniques that can be used to increase the vigor of various plant species, especially grasses. Although the initial results are often spectacular, the beneficial effects are often short term. Aerial application of fertilizers has been utilized on sparse sagebrush-grassland slopes adjacent to the refuge to increase grass productivity and attract wildlife particularly wintering mule deer and elk. To date, fertilizers have not been used on the refuge as a habitat management tool.

The entire refuge boundary is fenced while the interior consists primarily of old deteriorating conventional fence with some one strand electric fencing. Several miles of old fence needs to be removed to improve visual aesthetics. New fencing patterns,

utilizing permanent and temporary "lay down" one-strand electric fences would allow for the implementation of innovative grazing systems and eliminate barriers to wildlife movement, particularly pronghorn antelope.

There are specific areas throughout the refuge where water facility development and/or rehabilitation would benefit wildlife and assist planned grazing programs to improve the overall health of plant communities. Although windmills have been used in the past, the use of solar power to pump existing wells and the development of small ponds in existing drainages or adjacent to meadows would be preferred. The elimination of old windmills would improve visual aesthetics and reduce annual maintenance costs.

Transplanting various types of native aquatic and/or water associated plants to improve habitat for wildlife is an ongoing endeavor on the refuge. Because of the high elevation, the presence of such native wetland associated plants as cattail and hard stem bulrush are limited. Entire plants including shoots and tubers have been transplanted to numerous wetland sites on the refuge with moderate success. Some riparian areas along the Illinois River where willow habitat had previously been destroyed either mechanically or through aerially spraying have been renovated through the transplanting of young willow shoots.

Noxious weed control is a legal requirement on most refuges. Canada thistle is the primary noxious weed found on the refuge although yellow toadflax has also been identified on one area in the southwest corner of the refuge. In the past, efforts to control Canada thistle were limited primarily to spraying 2-4D herbicide. These efforts were minimally successful and in 1988, all chemical spraying was curtailed and biological control in combination with mowing and livestock grazing were implemented.

The initial biological agent released was the stem mining weevil, Ceutorhynchus litura, followed later by the Canada thistle stem gall fly, Urophora cardui. The stem mining weevil has established populations on several areas of the refuge and slowly has contributed to the control of Canada thistle in specific areas. Along with limited mowing along roadsides, parking areas, etc., cattle have been used in heavy Canada thistle infestation areas to help control thistle. Cattle often prefer to graze the young flowering thistle plants prior to seed head formation.

C. Management Alternatives Considered and Evaluated

The following management alternatives were reviewed and analyzed with regards to having the best potential and ultimate success in enhancing and maintaining various plant communities to assure in perpetuity, the refuge's overall purpose and mission and that associated goals and objectives are realized:

1. No Management (Balance of Nature) Alternative

With the exception of total complete rest (long-term), none of the habitat management tools previously discussed would be utilized. The forces of nature would be allowed to proceed on its own course.

Only the occasional wildfire caused by lightning or initiated from some other source, together with the amount of noxious weed control necessary to meet legal requirements would be permitted. Wildfires would be allowed to burn various refuge habitats as long as they can be maintained under control and are entirely extinguished before entering non-refuge lands. Prescribed burning would not be conducted on any of the sagebrush-grassland, meadow or riparian communities.

Planned grazing, meadow irrigation and all other water level manipulation activities would cease. Wetland and associated meadow habitats would be allowed to evolve towards a more xeric type of environment. Sagebrush-grassland uplands would eventually become more shrub dominated with less grasses and forbs. Monitoring and evaluation of changing habitat conditions would not be conducted.

2. Prescribed Burning with Irrigation/Water Management Alternative

All grazing and haying management activities on the refuge would cease. Prescribed burning would be utilized exclusively and very frequently under this habitat management alternative. As much as 5,000 to 6,000 acres would have to be burned each year to maintain optimum habitat diversity. Approximately 12,000 acres would receive complete rest each year. Fire would be used much more with this alternative compared to other alternatives and would require extensive planning and preparation along with an increased "state of readiness" of personnel and equipment during the burn seasons. All prescribed burning would be conducted

within the constraints of the station Fire Management Plan and approved annual burn proposals. Other secondary management tools such as plant transplants, grass seeding, and noxious weed control would be utilized on a limited and/or as needed basis.

Flood irrigation of up to 7,500 acres of meadow would continue to provide shallow, well dispersed open water areas along with a diversity of grasses, forbs and grass like plants (aquatic) for the benefit of many wildlife species. Water level manipulations in over 60 individual ponds (marshes) totalling over 775 acres would continue to maintain optimum conditions for wildlife, particularly waterfowl and other migratory birds.

3. Planned Grazing with Irrigation/Water Management Alternative

All prescribed burning management activities on the refuge would cease. Planned grazing/animal impact would be the primary management tool utilized to enhance and maintain the vigor and diversity of plants within the three plant communities. Approximately 12,000 acres of meadow, and sagebrush-grassland uplands would need to receive some type of grazing/animal impact treatment annually. Increased grazing would require additional planning efforts and the installation and/or construction of more grazing associated facilities such as fences, water developments, etc. All grazing would be conducted within the constraints of the station's Grazing Management Plan. Over 6,000 acres would be rested entirely on an annual basis. Other secondary management tools such as haying, grass seeding, noxious weed control, etc. would be utilized on a limited and/or as needed basis.

The irrigation of 7,500 acres of meadow habitats and the manipulation of water levels in 60 plus refuge ponds (marshes) to create and maintain optimum habitat conditions for wildlife would continue basically at the same level of intensity as in the previous prescribed burning alternative. The use of water for irrigation and water level manipulations would be limited only by and dependent upon the amount of water available.

4. (No Change from Present Management) Inter-disciplinary/Integrated Management [Ecosystem Based] Alternative - "Preferred Alternative"

This alternative provides the greatest number, variety and combination of management tools, to select from to enhance and

maintain refuge habitats. Depending upon desired affect, ease of use, costs, direct and indirect affects within the watershed outside refuge boundaries, etc. all potential tools would be considered and evaluated. On an acreage basis, grazing/animal impact (growing season and dormant season) would be the primary management tool utilized along with meadow irrigation, water level management, prescribed burning, haying, rest, grass seeding, plant transplants, etc. Acreages expected to be treated through the use of each management tool on an annual basis are as follows:

Grazing/animal impact	-	9,000 to 11,000
Meadow irrigation	-	7,000 to 7,500
Prescribed burning	-	300 to 500
Haying	-	100 to 250
Rest (one or more years)	-	5,500 to 6,500
Water level management	-	500 to 650
Vegetative transplants	-	5 to 15
Grass seeding	-	5 to 15

The use of each tool and its affect on wildlife populations and their habitat will be monitored and evaluated by standardized, simple techniques including transects, population counts, ocular observations and other methods.

All management actions would be reviewed and evaluated within the context of a much larger ecosystem or ecosystems area than that of just refuge lands only. The refuge is currently an active partner along with several other Federal and State agencies, organizations and private landowners in the recently established Owl Mountain Ecosystem Partnership. The partnership project boundary covers a major portion of North Park or Jackson County and totals approximately 245,000 acres, and involves the Michigan and Illinois River drainages which includes the entire refuge. The Owl Mountain Partnership has established the following goals for the project area:

- a. Create partnerships that build trust and team work to achieve ecosystem health and resolve resource conflicts which will serve the economic, cultural and social needs of the community.
- b. Develop and implement an adaptive ecosystem management plan across political, administrative

and ownership boundaries based on identified issues and needs.

- c. Document the implementation process of ecosystem management and communicate knowledge gained from the project to partners and the public.

This alternative involving a integrated, coordinated and holistic approach to resource management is bolstered by the Fish and Wildlife Service's recent decision to institute ecosystem management Nationwide. The Service chose to establish ecosystem management units across the Nation based on major watersheds of which the Platte/Kansas Rivers Watershed is one of 52 ecosystem areas. The Owl Mountain Partnership area includes two major tributaries of the North Platte River; the Illinois and Michigan Rivers. They supply water that supports natural resources within the entire Platte/Kansas River Watershed Ecosystem.

D. Management Alternatives Considered But Not Evaluated

1. Increased Economic Return Alternative - This alternative would rely heavily on using those management actions or uses that provide a substantial increase in funds (receipts) returned to the refuge or refuge system. Emphasis would be placed on increasing grazing and haying as management tools on the refuge. Some type of fee system would be initiated for all public use activities. Prescribed burning and long-term rest treatments would be eliminated. Optimizing refuge goals and objectives while at the same time increasing refuge receipts would require an extremely delicate balancing act. This alternative was dropped from further evaluation as refuge goals and objects could not be met.
2. Historic Landscape (Native American) Alternative - Although this alternative is quite idealistic, it is not entirely impossible. Refuge habitats would be managed entirely from a Native American perspective and all on ground decisions and activities would be made and conducted by Native Americans, probably from the Ute Nation, recruited and selected by the Service. Bison, rest and prescribed fire would probably be the preferred management tools. Water diversions would probably cease and all or most water flows would be returned to natural stream courses. Native Americans would determine what types, if any, of public use activities that might be permitted and how. This alternative is not a viable

option as a change in the current Service policy (Refuge Manual 7RM 5.2) which states that "Bison and Texas longhorn cattle will not be introduced onto any National Wildlife Refuge except those listed for these species", would be required to permit the use of bison as a management tool on the refuge.

III. THE AFFECTED ENVIRONMENT

The refuge currently encompasses 23,267 acres and when all proposed lands are fully acquired and land exchanges complete, the refuge will consist of approximately 24,080 acres. The refuge, excluding the recent Stelbar acquisition (5,014 acres), presently consists of 7,944 acres of irrigated and sub-irrigated meadows, 9,286 acres of sagebrush-grassland uplands, 771 acres of wetlands, 188 acres of riparian willow and stream habitat, and 64 acres of administrative lands including building sites and roads.

The refuge produces an average of 7,275 ducks (10 year average) and 150 to 300 Canada geese annually although production varies from year to year. The current refuge objective is to produce 11,000 to 12,000 ducks and 500 Canada geese annually. To meet waterfowl production objectives and provide optimum habitat conditions for other species of wildlife, the refuge utilizes several habitat manipulation techniques such as pond development, water level manipulation, irrigation, rest-seasonal and short duration grazing systems, haying and prescribed burning to create habitat diversity and maintain vegetative vigor, growth and density.

Soils on the refuge fall into two broad categories, soils of the low terraces, flood plains and irrigated benches and soils of the benches and uplands. The former are sandy loam, loam and clay loam soils formed in alluvium and outwash. They are poorly to well-drained and are generally moderately deep over sand and gravel and are level to gently sloping. The latter are sandy loam, loam, and clay loam soils formed in alluvium outwash or weathered sandstone or shale. They are shallow to deep, nearly level to steep and are well drained.

The high elevation and northern latitude provides North Park with a unique climate. The refuge elevation ranges from 8,100 to 8,700 feet. North Park is classified climatically as a cold desert. Winters are very cold and normally have 60 inches or more of snow while the surrounding mountains receive at least 120 inches of snowfall. Extremely low temperatures of minus 50 degrees have been recorded. Summers are cool and dry with high temperatures in the 80's and the average lows are near 40 degrees fahrenheit. Mean annual precipitation is only 9.6 inches and the mean annual temperature is 36.5 degrees fahrenheit. There is an average of only 30 consecutive frost free days each year.

The Illinois River transverses from south to north throughout the eastern half of the refuge and provides most of the water needed to irrigate refuge meadows and maintain waterfowl brood ponds. The watershed drainage for the Illinois River is 177,320 acres and includes National Forest, Bureau of Land Management and private land.

Arapaho NWR consists of three major plant communities. The first and largest of these is the sagebrush-grassland community consisting of approximately 9,286 acres which borders the meadow and extends into and throughout the higher rises on the refuge. In some areas the sagebrush-grassland community is interspersed within the meadow community. Characteristic native flora include big sagebrush Artemisia tridentata, greasewood Sarcobatus vermiculatus, winterfat Ceratoides lanata, mat saltbrush Atriplex corrugata, alkali sagebrush Artemisia longiloba, rabbitbrush Chrysothamnus viscidiflorus, western wheatgrass Agropyron smithii, streambank wheatgrass Agropyron rirarium, bluebunch wheatgrass Agropyron spicatu, siltgrass Distichlis stricta, alkali bluegrass Poa juncifolia, junegrass Koeleria cristata, pine needlegrass Stipa pinetorum, mutton grass Poa fendleriana and sheep fescue Festuca ovina.

The meadow community totals approximately 7,944 acres. Characteristic native flora include tufted hairgrass Deschampsia caespitosa, Nebraska sedge Carex nebraskensis, oval head sedge Carex festivella, Baltic rush Juncus balticus, Thurber fescue Festuca thurberi, and slender wheatgrass Agropyron trachycaulum. Some common introduced species include redtop Agrostis palustris, timothy Phelum pratense, and foxtail barley Hordeum jubatum.

Ponds, marshes and the Illinois River and associated riparian habitat make up the third community totaling approximately 959 acres. Common native plants found in association with the refuge's wetlands include the common cattail Typha latifolia, long style rush Juncus longistylis, wigeongrass Ruppia maritima, white water buttercup Ranunculaceae aquatilis, redhead grass Potamogeton richardsoni and threadleaf pondweed Potamogeton filiformes. Various species of willow Salix sp. characterize the riparian habitat along the Illinois River.

A variety of wildlife including over 187 species of birds, 32 species of mammals and nine species of fish have been identified on the refuge. Waterfowl, for which the refuge was primarily established, make the greatest use of the area. The first waterfowl arrive when the ice vanishes in April or early May.

The spring migration peaks in late May when up to 5,000 ducks may be present. Primary nesting species include the mallard Anas platyrhynchos, pintail Anas acuta, gadwall Anas strepera, and American widgeon Anas americana. A number of diving ducks including the redhead Aythya americana and the lesser scaup Aythya affinis nest on and adjacent to the various ponds and may be observed

during the entire summer season. Fall migration reaches its peak in late September or early October when up to 6,000 ducks are present. Canada geese Branta canadensis were re-established in North Park in the late 1960's by the Colorado Division of Wildlife. The nesting population on the refuge has been increasing the past several years.

A variety of other marsh and water birds are attracted to the refuge wetlands each year. Some of the more numerous species include the Wilson's phalarope Steganopus tricolor, American avocet Recurvirostra americana, willet Catoptrophorus semipalmatus, lesser yellowlegs Totanus flavipes, black-crowned night heron Nycticorax nycticorax and eared grebe Podiceps caspicus.

Birds associated with the refuge uplands include the Brewer's sparrow Spizella breweri, sage thrasher Oreoscoptes montanus, horned lark Eremophila alpestris, mountain bluebird Sialia currocoides, black billed magpie Pica pica, and sage grouse Centrocercus urophasianus. Raptorial birds are common with the Swainson's hawk Buteo lagopus, Northern harrier Circus cyaneus, ferruginous hawk Buteo regalis, and short-eared owl Bubo virginianus and the burrowing owl Speotyto cunicularia being most numerous.

Mammals such as the white-tailed prairie dog Cynomys gunnisoni, Richardson's ground squirrel Citellus richardsoni, white-tailed jackrabbit Lepus townsendi, least chipmunk Eutamias minimus, long-tailed weasel Mustela frenata, striped skunk Mephitis mephitis, muskrat Ondatra zibethica, and beaver Castor canadensis are abundant on the refuge. Other mammals present but less common are the yellow-bellied marmot Marmota flaviventris, raccoon Procyon lotor, badger Taxidea taxus, coyote Canis latrans, mink Mustela vison, porcupine Erethizon dorsatum and moose Alces alces. Mule deer Odocoileus hemionus and elk Cervus elaphus are present on the refuge throughout the year with peak populations of 400 and 800 animals respectively during the winter months. Pronghorn Antilocapra americana populations vary between 100 and 300 animals throughout the year.

The Illinois River has several species of fish present. The most common game species is the brown trout Salmo trutta with several species of suckers Catostomus sp., chubs Hybopsis sp. and shiners Notropis sp. Also present but in fewer numbers are rainbow trout Salmo gairdnerii, brook trout Salvelinus fontinalis, and the Johnny darter Etheostoma nigrum. The Johnny darter is listed as a threatened species by the State of Colorado.

Eight major invertebrate families are present in most of the refuge's ponds and wetlands and in the Illinois River. They include the families Chironomidae (midge larvae), Lymnaeidae (gastropod), Corixidae (water boatman), Planorbidae (gastropod), Baetidae (mayflies), Dytiscidae (diving beetles), Talitridae

(amphipod) and Gammaridae (amphipod). A minimum of at least 34 other invertebrate families are also known to occur on the refuge.

Endangered species that are occasionally observed on the refuge (one to two observations every two years) are the American peregrine falcon Falco peregrinus and the bald eagle Haliaeetus leucocephalus. Both of these species are on the Federal and State of Colorado's list of endangered species. The river otter Lutra canadensis and greater sandhill crane Grus canadensis tabida are also occasionally observed on the refuge and are listed by the State of Colorado.

The Platte River watershed system downstream in Nebraska also provides habitat for the endangered and/or threatened whooping crane, piping plover, American burying beetle and the Western prairie fringed beetle and the Western prairie fringed orchid. These four species and their habitat could possibly be indirectly affected by the additional use of water for management purposes on the refuge or in North Park.

Archeological reviews have been completed over much of the refuge. No significant archeological sites are known to exist on the refuge at the present time other than an area on the south half of Section 15, T8N, R80W which is recognized as a "campsite" by the State of Colorado.

Natural gas and oil deposits are not known to exist on the refuge at the present time. Deposits of coal however, are present although their quality, quantity and depth of overburden are undetermined.

IV. ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Each alternative is briefly discussed and evaluated in terms of expected effects on the human environment. For a brief review of each alternative and its anticipated effect on various resource issues refer to Table 1.

A. No Management (Balance of Nature) Alternative

This alternative would eliminate all management treatments to refuge habitats except that of total rest and the infrequent wildfire. Vegetation would respond favorably initially but then would eventually stagnate resulting in reduced vigor and decreased new plant growth. Plant diversity would decline followed by a subsequent decrease in many wildlife species. A decline in the water cycle, mineral cycle and energy cycle would be expected along with an increase in the amount of bare soil followed by increased soil erosion activities.

With no irrigation, refuge meadows could be expected to change dramatically from normal wet meadow plant species to species more adapted to drier soil conditions. Most refuge ponds and marshes would eventually dry up and would be invaded by early successional weed and grass species. Waterfowl and other water bird populations would decline drastically, with some disappearing from the refuge completely. Other wildlife populations would either remain stable or eventually decrease also. No major change in endangered species populations (bald eagle and Peregrine falcon) would be expected.

With the elimination of all irrigation activities, additional water would be available to maintain stream flows in the Illinois River, benefitting fish and other aquatic species such as the beaver, muskrat and otter (State listed) which are dependent upon adequate water flows. At least, theoretically, additional water would be available downstream in the Platte River watershed system to benefit the endangered and/or threatened whooping crane, piping plover, American burying beetle and the Western prairie fringed orchid.

Significant negative impacts to the local economy would probably occur if this alternative were selected. Currently, seven different individuals rely at least partially on refuge forage for their livestock operations and would be adversely affected by this alternative. The refuge revenue sharing program would also be negatively affected.

Local support for refuge programs such as the Private Lands Program, YCC Program, land acquisition program and the multi-agency-landowner based Owl Mountain Partnership would deteriorate. Most people would view this no management alternative as a waste of valuable natural resources and as a safety hazard to surrounding landowners. Significant controversy would occur and the Government would be the villain again.

Conclusion - The long-term implications of this alternative on wildlife, wildlife habitats, the local economy and overall public relations within the community are devastating. Wildlife and plant community diversity and richness would decline, eventually leading to reduced public use activities. Refuge goals and objectives would never be fully realized and actually would decrease from current levels. This alternative, therefore, is not compatible with the major purpose for which the refuge was established.

B. Prescribed Burning with Irrigation/Water Management Alternative

This alternative would use prescribed burning along with irrigation and water level manipulation as the primary habitat management tools. Since

grazing and haying would be curtailed, a significant increase in the amount of refuge acreage would have to be burned on an annual basis. An estimated 5,000 to 6,000 acres would need to be treated each year to maintain optimum habitat diversity and vigor. If weather conditions were unfavorable and prevented treatment in any year, or for several years, vegetation would tend to become monotypic. Wildfire danger would accelerate and threaten lands and facilities adjacent to the refuge. Air pollution would occur on a temporary basis.

Wildlife populations would change somewhat under this alternative as most species have adapted to both grazing and fire. Grazing is a natural component of the North Park area since bison were once abundant. The net change in wildlife populations is not easy to predict, but it is obvious that while some species such as the killdeer and prairie horned lark would benefit, other species such as the sage grouse and most waterfowl would suffer from prolonged burning treatments. Populations of the endangered bald eagle and Peregrine falcon (occasional visitors) would not be significantly affected.

Negative effects may occur to soil by creating bare areas susceptible to erosion and a loss of nutrients. Soil heating could increase evaporation and transpiration.

Sagebrush-grasslands would benefit from prescribed burning by setting back woody species and encouraging grasses and forbs. Also, fire tends to dramatically increase the presence of rabbitbrush plants in the sagebrush-grassland community, to levels above that desired.

With irrigation and water level manipulation available as additional management tools, refuge meadows would benefit initially but would eventually revert to monotypic stands of vegetation with reduced vigor because of extensive burning treatments. Marshes and ponds would remain in good condition as long as adequate water supplies were available for water level manipulation. Willow habitat would be enhanced through the use of prescribed burning to encourage the growth of new young willows in decadent willow stands throughout the refuge. Additional monitoring and evaluation of various burn treatments would be required involving transects, population counts and ocular observations.

As in the "No Management Alternative" significant negative impacts to the local economy would occur, as all grazing treatments and one haying operation would be terminated. Local support for refuge programs would diminish and controversies would increase. The value of partnerships in

building trust and using teamwork to accomplish common and shared goals would be lost.

Conclusion - Although the no grazing or haying alternative would temporarily achieve refuge goals and objectives, in the long-term, goals and objectives would decrease and level off. Full objective levels would never be reached and maintained. For this reason, the prescribed burning only alternative is not acceptable as a desired alternative.

C. Planned Grazing with Irrigation/Water Management Alternative

This alternative would use grazing/animal impact along with irrigation and water level manipulation as the primary habitat management tool. Since prescribed burning treatments would be curtailed, a increase in grazing/animal impact treatments would be needed. Approximately 12,000 acres would need some type of grazing treatment annually. Both growing season and dormant season grazing treatments would be utilized. This in turn would require additional planning, monitoring, and facility developments such as fencing, water developments, etc.

There will be some negative aesthetic impacts as most refuge visitors do not like to see cattle on National Wildlife Refuges. This will require an extra educational effort, on the part of refuge personnel to familiarize the visiting public on the value and use of grazing as a habitat management tool.

As in the prescribed burning alternative, wildlife populations could be expected to change somewhat, but not drastically. Depending upon the timing of grazing treatments, some ground nesting bird species could be adversely affected, at least temporarily. In the long-term most wildlife species would benefit as plant communities would maintain their diversity and vigor at least at current levels. The bald eagle and peregrine falcon would remain at or near current populations levels.

Some negative effects will occur in spot areas where cattle graze repeatedly because of preferred plant species. These species will suffer as they loose vigor and are eventually displaced by other less desirable species. Other plant species and soils will benefit from the actions of cattle by trampling, soil compaction, etc. which help compact the soil and help spread and plant grass seeds.

Sagebrush-grasslands would benefit from early short-duration grazing accompanied with animal impact activities by breaking up capped soils, increasing mulch on bare soil and spreading grass seed. Most refuge

sagebrush-grasslands exhibit an over dominance of woody species such as sagebrush, greasewood and rabbitbrush. Grazing treatments would help increase the percentage of forbs and grasses on refuge uplands.

Irrigation and water level manipulation would maintain meadow and marsh habitats in a fair to good condition for a few years. However, with grazing as the only tool available to disturb plant communities (haying not being practical on a large scale), expanses of monotypic vegetation would eventually be expected over many years.

Prescribed burning would not be available as a management tool to rejuvenate old decadent willow riparian areas. It is highly unlikely that livestock could be utilized to replace prescribed burning to accomplish the rejuvenation.

As this alternative would provide some increased livestock forage for local landowners, a very positive reaction would be expected from local residents. Local support for refuge programs would at least remain at the current level and possibly increase. As ranching is the major business in Jackson County, any forage in the form of grazing that the refuge can provide is looked upon favorably in the community.

Conclusion - Grazing can be, and is, a very important management tool on the refuge. However, grazing is not the only management tool available. Grazing is not always the appropriate tool to use in certain situations and when used alone, optimal wildlife and habitat can never be fully realized. For this reason the "grazing only alternative" although adequate is not the best alternative available.

D. (No Change from Present Management) Inter-Disciplinary/Integrated Management [Ecosystem Based] Alternative - "Preferred Alternative"

This alternative would use a variety of management tools either singly or in concert with each other. Tools will be implemented based on many factors including appropriateness, ease of use, cost effectiveness, etc. The beauty of this alternative is that it allows for flexibility and solicits the advice and comments of others prior to implementing specific habitat management treatments.

Although some initial negative short-term effects regarding wildlife and plant communities can be expected with the use of some management tools such as prescribed burning and grazing, in the long-term most if not all wildlife species will benefit as will the plant communities. The bald eagle

and Peregrine falcon will benefit because a more diverse and vigorous habitats which in turn provides more prey species for these two species.

In the long-term this alternative will permit waterfowl production to reach or exceed current objective levels. Other migratory birds and resident wildlife are expected to react to healthier habitats with increased populations. Improved riparian habitats through the use of rest, specialized grazing systems, animal impact and a more efficient use of water resources, will benefit fishery resources and other aquatic species. After several years, both riverine water quality and quantity should improve.

Soil productivity should show signs of improvement with added mulch, less bare ground and an increase in density of new grass and forb plants. Soil erosion due to wind and water is expected to decline.

Air quality and visual aesthetics are expected to remain basically unchanged. Only temporary negative effects would be expected during, and shortly after, a prescribed burn or wildfire.

Irrigation and water level manipulation will maintain most meadow and marsh habitats in good to excellent condition. Any additional water depletion caused by new wetland development and/or enhancement would be compensated for by releasing stored water from other small reservoirs and/or through a decreased use of legal irrigation water rights on the refuge. With a combination of grazing, haying, prescribed burning, and rest as management treatments, plant communities will improve in overall condition and maintain long-term diversity and vigor.

No effect is expected on any cultural or archeological resources that may exist on the refuge.

This alternative would provide a moderate amount of forage to local landowners through grazing and haying treatments. The amount of forage would however, be some what less than that provided under the grazing/animal impact alternative. Forage is a secondary benefit of using grazing and haying as management tools to enhance and maintain habitat quality. The availability of a moderate amount of forage for permittees is expected to receive a favorable reaction although they always would like to have more. No major negative controversies are expected to develop within the community from the implementation of this alternative.

Conclusion - This alternative is preferred to all of the other alternatives because it involves a well rounded, flexible program that best addresses

and balances the needs of our natural resources with, and for, the benefit of the people. It also best emulates natural processes which existed prior to European settlement and thus will result in environmental conditions more closely resembling that which would have occurred without the interference of settlement

V. CONSULTATION AND COORDINATION

Input on the preparation of this draft environmental assessment of habitat management alternatives for Arapaho National Wildlife Refuge was solicited from a variety of individuals, organizations and agencies.

A draft EA was mailed to all individuals, organizations and agencies who had expressed an interest in the management of the refuge to provide them an opportunity to comment on the document. News releases regarding the availability of the draft environmental assessment were also sent to the Walden and Fort Collins, Colorado newspapers. The Service considered and incorporated those comments as appropriate in the final assessment. A Notice of Decision will be mailed to all individuals who expressed an interest in the Service's decision based on the assessment.

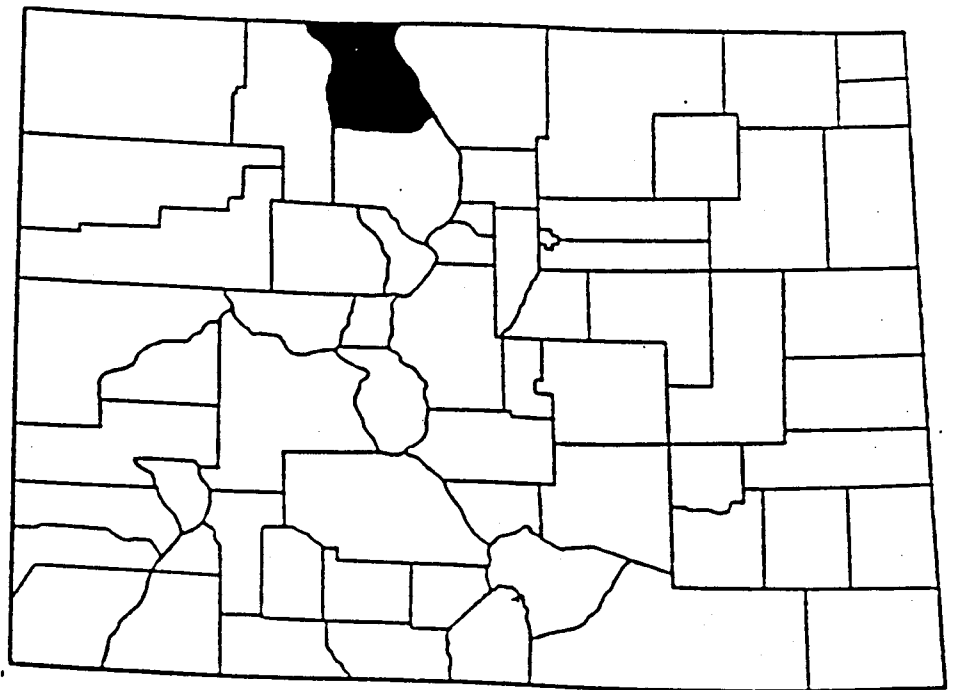


FIGURE 1
General Location Map of Jackson County
Colorado

Jackson County with Arapaho NWR & Habitat Communities

Figure 2



ARAPAHO BOUNDARY








-  MEADOW LAND
-  BARREN LAND
-  FOREST LAND
-  RANGELAND
-  TUNDRA
-  URBAN OR BUILT-UP LAND
-  WATER
-  WETLAND

Table I. Matrix

Environmental Consequences

MAJOR ISSUE	NO MANAGEMENT ALTERNATIVE		PRESCRIBED BURNING w/IRRIGATION /WATER MGMT ALTERNATIVES		PLANNED GRAZING w/IRRIGATION WATER MGMT ALTERNATIVE		INTER- DISCIPLINARY/ INTEGRATED ECO BASED ALTERNATIVE	
	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term
T&E Species	0	-	-	0	-	0	0	+
Waterfowl	=	=	-	+	-	+	-	++
Other Waterbirds	=	=	-	+	-	+	-	++
Other Migratory Birds	-	=	-	0	-	0	-	+
Large Ungulates	0	+	-	+	-	+	-	++
Other Resident Species	0	-	-	0	-	0	-	+
Fish & Other Aquatic Species	0	+	0	0	0	0	0	+
Wildlife Diversity	0	-	0	-	0	-	0	++
Soils	0	-	0	-	0	-	0	+
Riverine Water Quality & Quantity	+	+	0	0	0	0	0	+
Air Quality	0	0	-	0	0	0	-	0
Visual Aesthetics	0	-	-	+	-	-	0	+
Plant Vigor & Diversity	0	=	+	-	+	-	-	+
Vegetation/ Habitat Quality	0	=	+	-	+	-	-	+
Pond/Marsh Habitat	=	=	0	0	0	0	0	+
Cultural Resources	0	0	0	0	0	0	0	0
Local Socio- Economic Impacts	-	=	-	=	+	++	+	++
Station Goals & Objectives	-	=	0	-	0	0	+	++

SHORT TERM: Effects during or shortly after management & action has been implemented (usually less than a year).
LONG TERM: Overall effects from 1-20 years later.

=: VERY DETRIMENTAL EFFECT

-: DETRIMENTAL EFFECT

0: VERY LITTLE OR NO
EFFECT

+: BENEFICIAL EFFECT

++: VERY BENEFICIAL EFFECT

I. LITERATURE CONSULTED

- Anderson, E.W. and R.J. Scherzinger, 1975. Improving Quality of Winter Forage for Elk by Cattle Grazing Journal of Range Management 28 (2) 120-124 pp.
- Bunting, Stephen C. et al., 1987. Guidelines for Prescribed Burning Sagebrush-Grass Rangelands in the Northern Great Basin. USDA Forest Service Intermountain Research Station Gen Tech Report INT-231 33 pp.
- Chaney, Ed et al., 1990. Livestock Grazing on Western Riparian Areas, EPA, NW Resource Info Center, Inc., Eagle, ID 44 pp.
- Clary, Warren P. and Bert F. Webster, 1989. Managing Grazing of Riparian Areas in the InterMountain Region. USDA Forest Service Intermountain Research Station Gen Tech Report INT-263 11 pp.
- Cosby, Hugh E. and Stephen S. Berlinger, 1973. Altering Influences and Certain Management Effects on Range Ecosystems. US Fish and Wildlife Service, Lake Andes, South Dakota 32 pp.
- Elmore, Wayne and Robert L. Beschta, 1987. Riparian Areas: Perceptions in Management, Rangelands 9 (6): 260-265.
- Folzenlogen, Gordon H., 1968. Trip Report - Arapaho NWR Follow-Up Grassland Reconnaissance, Arapaho NWR files, Walden, CO.
- Frisina, H. R. and F.G. Morin, 1991. Grazing Private and Public Land to Improve the Fleecer Elk Winter Range. Rangelands 13(6) 291-294 pp.
- Hampton, H.D., 1971. With Grinnell in North Park, The Colorado Magazine XLVII/4 273-298 pp.
- Higgins, Kenneth F. et al., 1986. Effects of Fire in the Northern Great Plains. US Fish and Wildlife Service and Cooperative Extension Service, South Dakota State University, USDA Publication (EC 761) 47 pp.
- Holecheck, Jerry L. et al., 1982. Manipulation of Grazing to Improve or Maintain Wildlife Habitat. Wildlife Society Bulletin 10: 204-210.
- Jackson County Planning Commission, 1968. Comprehensive Long Range Plan. Jackson County, CO 42 pp.

- Kantrud, Harold A., 1986. Effects of Vegetation Manipulation on Breeding Waterfowl in Prairie Wetlands - A Literature Review. USDI, US Fish and Wildlife Service, Fish and Wildlife Technical Report 3, Washington, DC 15 pp.
- Kantrud, Harold A., 1983. Soils and Grazing Affect Use of Grasslands by Breeding Birds. Research Info. Bulletin 83:70, 2 pp., US FWS Northern Prairie Wildlife Research Center, Jamestown, ND.
- Kantrud, Harold A., 1981. Grazing Intensity Effects on The Breeding Avifauna of North Dakota Native Grasslands. Canadian Field Naturalist 95(4): 404-417. US FWS Northern Prairie Research Center, Jamestown, ND.
- Kirby, Ronald E., et al., 1992. Grazing on National Wildlife Refuges: Do the Needs Outweigh the Problems. Transactions of the 57th North American Wildlife and Natural Resources Conference 611-626 pp.
- Kirsch, Leo M. et al., 1978. Grazing and Haying Effects on Habitats of Upland Nesting Birds. Trans. of the 43rd North American Wildlife Conference, Wildlife Mgmt. Institute, Washington, DC.
- Knopf, Fritz L., 1987. Dormant-Season Grazing of Passerine Bird Habitats in Western Riparian Communities. Research Info Bull. 87:2, US FWS, Nat. Ecology Research Center, Fort Collins, CO 1 pp.
- Knopf, Fritz L., 1984. Impacts of Seasonal Grazing on Willow Riparian Communities. Research Info Bull. 84:72, US FWS, Nat. Ecology Research Center, Fort Collins, CO 1 pp.
- Managing Intermountain Rangelands - Improvement of Range and Wildlife Habitats. USDA Forest Service Intermountain Forest and Range Exp. Station, Ogden, UT General Technical Report, November 1983, 194 pp.
- Marlatt, LeMoyne B., 1967. Special Report - Irrigation and Haying Methods on the Allard Ranch, Jackson County, Colorado. Arapaho NWR files, Walden, CO.
- McHugh, Tom, 1972. The Time of the Buffalo. University of Nebraska Press 339 pp.
- Messmer, T.A., 1985. Effects of Specialized Grazing Systems on Upland Nesting Birds. M.S. Thesis, North Dakota State University, Fargo, ND 112 pp.
- Proceedings of the Third Intermountain Meadow Symposium, 1991. U. of Wyoming Agric. Experiment Station and Colorado State University, Mountain Meadow Research Center, Tech Bulletin LTB91 1-2 254.

- Savory, Alan, 1988. Holistic Resource Management, Island Press 545 pp.
- Schroeder, Lonnie D., et al., 1976. Effects of Early Water Application on Waterfowl Production. *Journal of Wildlife Management* 40: 227-232.
- Sedivec, Kevin, et al., 1989. Effects of Grazing Systems on Upland Nesting Waterfowl Species in South Central North Dakota - Phase III, North Dakota State University, Central Grasslands Research Center, Streeter, ND, Central Grasslands Research Center Annual Report 18-20 pp.
- Smith, Karen, 1990. Lostwood NWR Grassland Management and Prescribed Burning (briefing papers). Lostwood NWR files 6 pp.
- Symposium Proceeding, Management of Intermountain Meadows, 1979. U. of Wyoming Agric. Experiment Station and Colorado State University, Mountain Meadow Research Center 221 pp.
- USDA, 1981. Soil Conservation Service, Soil Survey of Jackson County, CO.
- USDI, Bureau of Land Management, 1983. An Archaeological Inventory in North Park, Jackson County, Colorado. Cultural Resource Series No. 14., Denver, CO.
- US Environmental Protection Agency, 1990. Livestock Grazing on Western Riparian Areas. Northwest Resource Information Center, Inc., Eagle, ID.
- Vallentine, John F., 1990. Grazing Management, Academic Press Inc. 533 pp.
- Vavna, Martin, et al. (ed), 1994. Ecological Implementations of Livestock Herbivory in the West Society for Range Management 1839 York St., Denver, CO 297 pp.
- Voisin, Andre, 1988. Grass Productivity, Academic Press Inc. 353 pp.

INTRA-SERVICE SECTION 7 EVALUATION

LOCATION: Arapaho National Wildlife Refuge, Walden, CO

LISTED SPECIES OR CRITICAL HABITAT CONSIDERED: Arapaho National Wildlife Refuge: peregrine falcon, bald eagle, Platte River watershed system; In addition to the above species the following species: whooping crane, piping plover, American burying beetle and Western prairie fringed orchid.

OBJECTIVES OF THE ACTION: The refuge will continue to use in various degrees, a variety of habitat manipulation tools to provide optimum habitat conditions for a variety of wildlife on the refuge, including threatened and/or endangered species. The use of these tools is designed to maintain a healthy refuge environment on a long-term sustainable basis.

IMPACT OF ACTION ON LISTED SPECIES OR CRITICAL HABITAT: The continued use of various habitat manipulation tools on the refuge is expected to have a positive effect on the small numbers of bald eagles and peregrine falcons that utilize refuge habitats at varying times of the year. Optimum habitat for wildlife also provides optimum populations of prey species for raptors. The development and enhancement of wetlands on the refuge could temporarily result in minute water depletions in the Platte River Watershed system which could indirectly impact some endangered species and/or their habitats downstream in Nebraska.

RECOMMENDATIONS TO AVOID ADVERSE IMPACTS OR ENHANCE SPECIES CONSERVATION: Any water depletions resulting from the development or enhancement of wetlands on the refuge as determined by the FWS, will be compensated for with the release of additional water from small refuge reservoirs or decreased use of legal irrigation water rights on the refuge.

CONCLUSION: The continued utilization of habitat management tools as in the past following the recommendation as discussed above will not directly or indirectly adversely affect any endangered and/or threatened species on the refuge or within the Platte River watershed system.

PROJECT LEADER: Eugene C. Patten

Date 8/22/94

MAY AFFECT: _____

WILL NOT AFFECT: X

COMMENTS:

ASSISTANT REGIONAL DIRECTOR NA DATE: _____

MAY AFFECT: _____

WILL NOT AFFECT: _____